Space Weather Technical Forecast

Issued on Friday, 28 April 2023 at 01:25 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Decreasing Chance of G1 through period. Chance R1/R2 throughout. Active electron fluence expected.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity was at Moderate levels over the past 24 hours, with occasional C-class activity and a peak of M1.8 at 27/1113UTC from AR3288 in the south-centre disc. The majority of the C-class flares were generated by AR3288, but also a few from AR3289. AR3288 remains the largest and most complex region on the disc, with currently an Eki/beta-gamma-delta classification, due to a small but clear Mt Wilson delta spot in an intermediate spot. As the region has shown a slight increase in size, there is a chance that a second small delta spot may develop within the lead spot. AR3289 appears to be a stable Dsi/beta-gamma, although the narrow viewing angle is currently making analysis tricky. The remaining sunspot regions appear small, weak and either stable or decaying slightly.

Despite a filament eruption, associated with a C3.0 from AR3289 at 27/0058UTC, no Earth directed CME is expected. This includes the previous Coronal Mass Ejections (CMEs) that have been seen leaving the northeastern limb over the past 24 hours.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by ACE/DSCOVR at L1, showed the continue influence of a fast wind regime from CH96/-. The solar wind speed was at elevated to strong levels throughout, averaging around 630 km/s at first and then around 580 km/s by the end of the day. The solar wind had a brief peak of 719 km/s at 27/0546 UTC. The solar wind density was below average. The IMF persisted at weak levels, of 8 nT or below. The north-south component fluctuated, ranging between +7 and -7nT, with no protracted negative periods observed. The phi angle remained negative (towards the Sun). The net effect of these solar wind parameters was for mainly Unsettled to Active activity (Kp 3-4).

Energetic Particles / Solar Radiation: High energy proton flux (greater than 10MeV) as measured at GOES16, has been at Background levels throughout.

High energy electron flux (greater than 2MeV) as measured at GOES16, was predominantly at moderate levels during the first half of the day, then increased after midday to reach mostly High levels. The associated 24-hour electron fluence was at Active levels until 27/1800 UTC, peaking at 1.12e8 integrated flux at 27/0600-0900 UTC. Thereafter a gradual decline occurred, and at 28/0000 UTC a fluence value of 8.39 e7 integrated flux was observed.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is Likely to remain Low, with a Chance of reaching Moderate levels. No significant regions leave and no returning regions are currently expected to rotate onto the visible disc, leading to a flat trend of probabilities.

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Solar Wind / Geomagnetic Activity: A filament eruption on 24 April produced a CME which was previously expected to produce a glancing blow at Earth. However, this CME is now overdue and appears to have missed Earth. Further filament eruptions on 25-26 April gave CMEs which are considered most likely to miss, but there is a very low risk of a glancing blows today and tomorrow (28 and 29 April).

Therefore the on-going HSS will dominate the forecast, with Elevate to Strong winds expected to persist today and tomorrow, and thereafter a gradual decline to slightly elevated levels by the end of the forecast period. Geomagnetic activity is expected to be Unsettled to Active (Kp 3-4) today and tomorrow, with a chance of isolated G1/Minor geomagnetic storm intervals (Kp 5) today, especially at first. Geomagnetic activity is expected to decline to become Quiet to Unsettled (Kp 1-3) during Days 3 and 4 (30th and 1st May).

Energetic Particles / Solar Radiation: Overall no solar radiation storms are expected, but there is a slight chance of a storm occurring over the four days due to the westward advance of AR3288.

High energy (greater than 2MeV) electron flux at GEO is currently at High levels, and is expected to remain at High levels for much of the forecast period, with only occasional dips down to Moderate levels today. This expected in response to the current HSS from CH96, with a decreasing chance of significant geomagnetic activity suppressing the electron flux. The associated electron fluence is expected to rise above the Active threshold (1e8 integrated flux) today, and then remain there for the rest of the forecast period.

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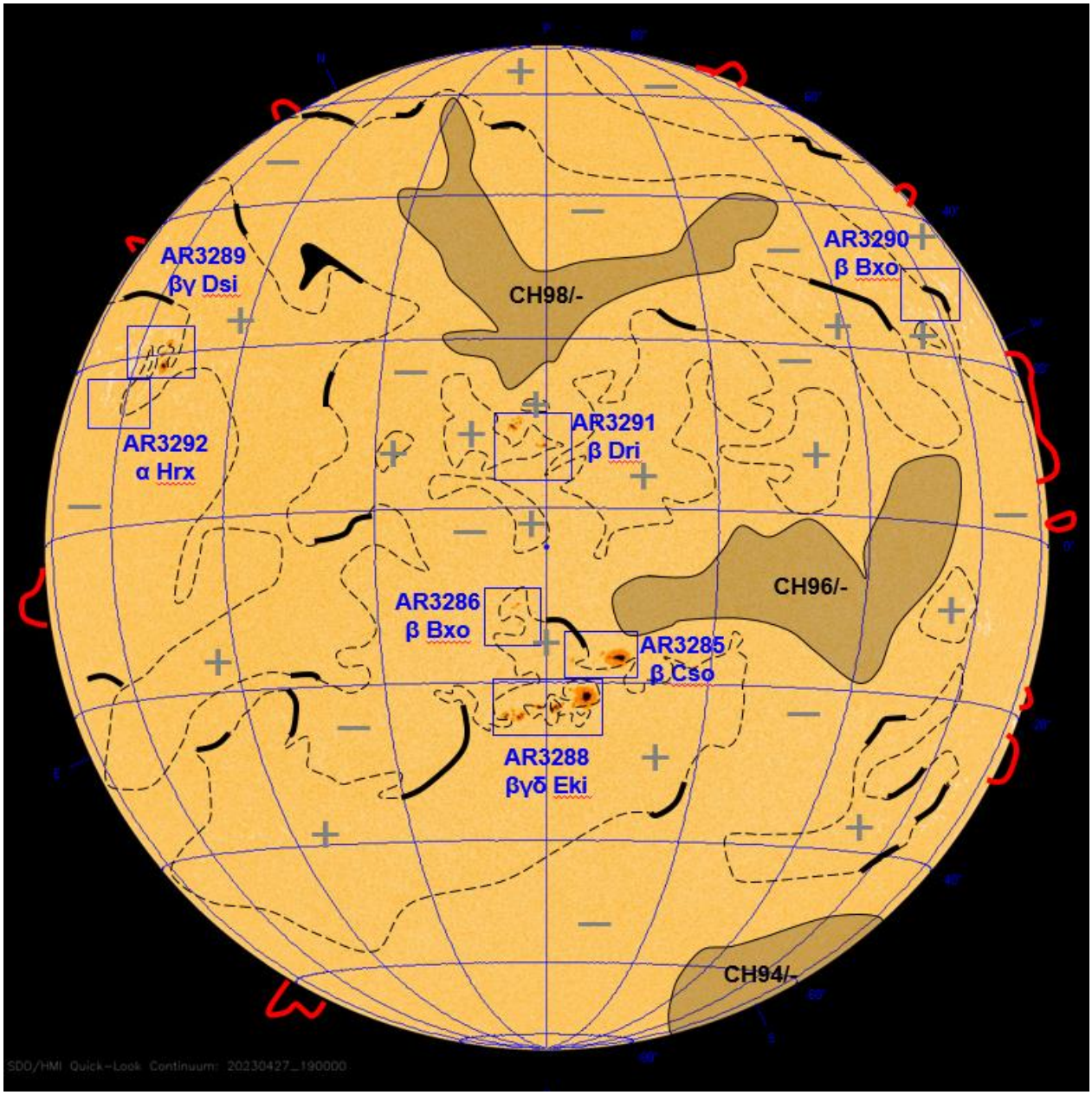
Figure 1. Solar Analysis Valid 27/1900 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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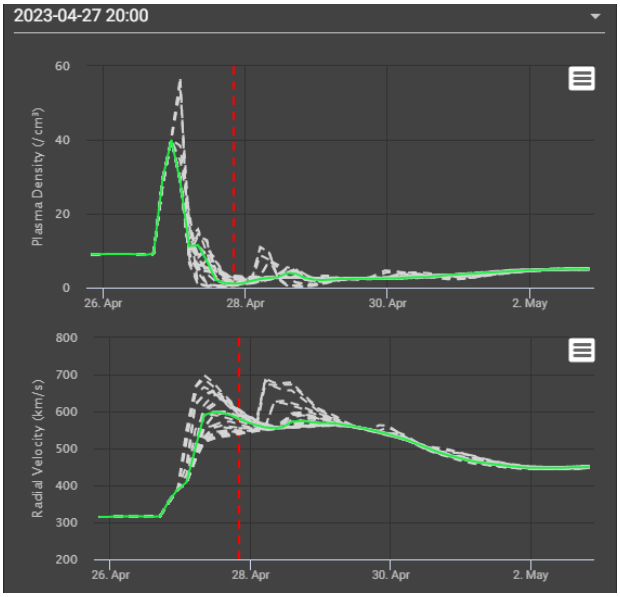
Geomagnetic Storms:

A filament eruption on 24 April produced a CME which was previously expected to produce a glancing blow at Earth. However, this CME is now overdue and appears to have missed Earth. Further filament eruptions on 25-26 April gave CMEs which are considered most likely to miss, but there is a very low risk of a glancing blows today and tomorrow (28 and 29 April). Therefore the on-going HSS from CH96 will dominate the forecast, although with a gradual decline, mainly from day 3 (30th) to slightly elevated levels by the end of the forecast period. Geomagnetic activity is expected to be Unsettled to Active (Kp 3-4) today and tomorrow, with a declining chance of isolated G1/Minor geomagnetic storm intervals (Kp 5). These are most likely today and tomorrow, while the solar wind remains Elevated to Strong, plus there is the very slight chance of glancing blows from the CME's. Geomagnetic activity is expected to decline to become Quiet to Unsettled (Kp 1-3) during Days 3 and 4 (30th and 1st May).

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	30	20	10	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Figure 2: Met Office MOSWOC Enlil ensemble forecast, showing a few members indicating possible weak CME arrivals today and tomorrow.



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Radio Blackouts - X-Ray Flares:

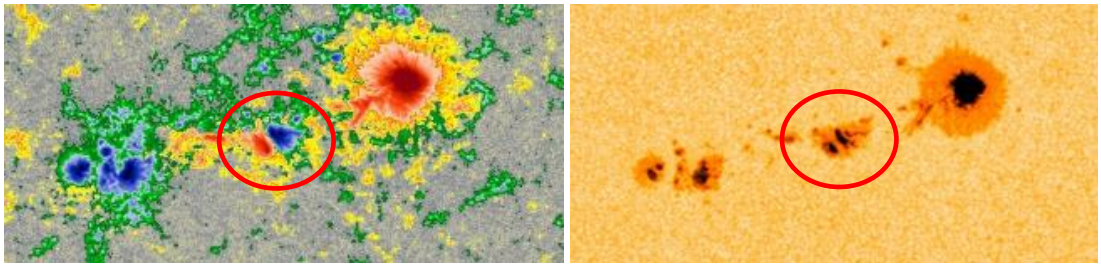
There are currently seven sunspot regions on the visible disc. The main change during the period is that AR3288 is now classified as Eki, with a slight increase in penumbra area, while remaining beta-gamma-delta because of a clear delta spot in an intermediate group. If an increase in penumbra continues with the lead spot then a second, small, delta spot may develop. Most other spotted groups appeared stable or in decay, with AR3290 now barely visible. AR3289 appears to be the only other region with some magnetic complexity, but also appears stable.

Only the small, weak and simple AR3290 is expected to leave the Earth-facing side in the period. In terms of returning Carringtons and persistent regions on the far side, there are not any due, however there appears to be a source for CME activity narrowly behind and perhaps on the northeastern limb at present, which may hint at a new arrival - to be determined through the next couple of days.

Solar activity over the past 24 hours has been Moderate. There is a Chance of further Moderate activity given any isolated M-class flares, most likely from AR3288.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	30	30	30	30
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: AR3288 with the delta spot as seen with SDO/AIA magnetogram (left) and intensitygram (right).



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Solar Radiation Storms - (High Energy Protons):

Overall no solar radiation storms are expected, but there is a slight chance of a storm occurring over the four days due to the westward advance of AR3288.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	5	5
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy (greater than 2MeV) electron flux at GEO is currently at High levels, and is expected to remain at High levels for much of the forecast period, with only occasional dips down to Moderate levels today during variations in the diurnal cycle. The predominantly High electron flux levels are expected in response to the recent Strong solar winds from the HSS from CH96, and for Elevated to Strong winds to persist today and tomorrow. Also, there is a decreasing chance of significant geomagnetic activity suppressing the electron flux.
The associated electron fluence is expected to rise above the Active threshold (1e8 integrated flux) today, and then remain there for the rest of the forecast period, with a slight but increasing chance of Very Active (1e9 integrated flux) levels being reached. Although the Met Office REFM is currently overestimating the fluence, the overall trend of an increasing fluence above the Active threshold is accepted as good guidance.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	90	90	90	90
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	5	10	20

Figure 4: Met Office REFM model.

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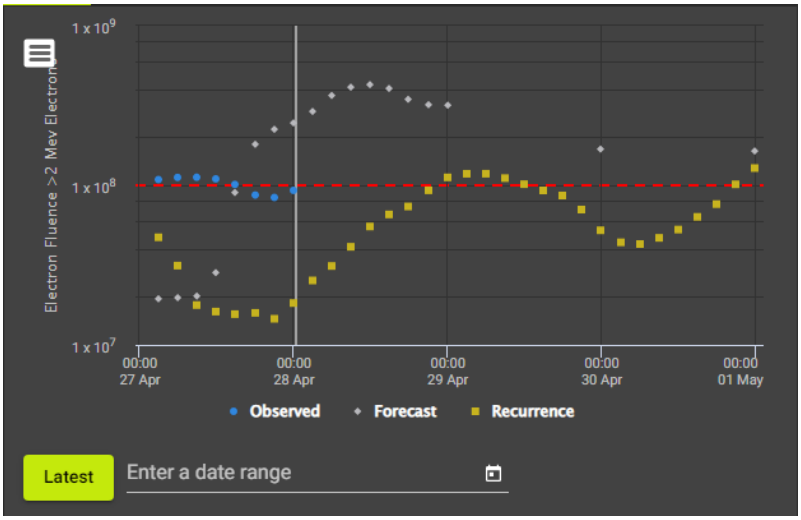

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